Reflective Review of "Using representational tools to learn

about complex systems: A tale of two classrooms"

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Describe

Hmelo-Silver, Liu, Gray, & Jordan (2014) present a comparative case research study

comparing two middle-school science teachers with different pedagogical approaches when

teaching similar content using identical technological tools. In the study, both teachers taught

complex systems understanding using an aquarium ecosystem as a model, and a suite of software

called "RepTools" which provided visual models of both macro- and micro-systems within a

virtual aquarium (Hmelo-Silver et al., 2014).

While both teachers engaged their classes in inquiry-based learning based on

constructivist principles, one teacher (Ms. Merritt) used a personal cognitive development

approach where knowledge construction is developed individually with structured teacher

guidance. In this context, the software suite was used as a reinforcer of teacher-provided

information, and as an assessment tool, rather than a source of primary inquiry (Hmelo-Silver et

al., 2014). The other teacher (Mr. Fine) had more of a sociocultural approach as well as

cognitive, which "stresses the importance of student agency toward meeting collaborative goals"

(Hmelo-Silver et al., 2014, p. 28). In that classroom students were given ill-defined problems,

were given more freedom to play with the software and create their own custom environments,

were encouraged to discuss problems amongst themselves and find answers to questions through

their own observations. The teacher played the role of a facilitator (Hmelo-Silver et al., 2014).

Quantitative measures (pre-and post-learning exams) and qualitative measures (coding of

behavior from observations of video-recordings) were both used to measure student

achievement. While some differences were observed, the authors reported that the students in both classes experienced similar gains (Hmelo-Silver et al., 2014). These findings differ from results of similar studies, where "the more effective teacher helped connect activities within the curriculum unit and among concepts and principles. The less effective teacher spent more time giving instructions to the students and focusing on isolated task completion" (Hmelo-Silver et al., 2014, p. 8). Compared to those studies, Hmelo-Silver et al. found that while Ms. Merritt did spend much of her time on providing instruction and giving her students defined tasks, "both teachers used the technology adeptly and that their use was consistent with systems-thinking goals" (Hmelo-Silver et al., 2014, p. 30).

Analyze/Reflect

Hmelo-Silver et al. (2014) write the article to present the data and conclusions of their comparative case study, which provides support for the assertion that inquiry-based learning is a valuable tool, regardless of the pedagogical approach of the teacher: "different instructional models can support student learning that leads to similar outcomes on content knowledge" (Hmelo-Silver et al., 2014, p. 28). The authors spend time discussing the theory behind each approach and why each may accomplish similar goals, an interesting exploration of theoretical foundations of learning.

The study was funded by the National Science Foundation, a federal agency whose mission includes supporting research in science education and publishing recommendations for teaching standards (National Science Foundation, n.d.). As such, the authors are also invested in promoting meaningful science education techniques. They specifically mention their research implications on the 2013 Next Generation Science Standards and professional development (Hmelo-Silver et al., 2014), so it is clear the authors hope their publication will affect policy and

teacher training. It was interesting to read about these implications, and some of the research behind the current standards.

I wanted to read this article because it addresses several concepts being discussed in my "Learning and Assessment" class, which is currently exploring constructivist principles, inquiry learning, and the debate between cognitivists constructivists and social-cognitive constructivists. Reading the article provided an excellent real-world example. It was interesting to learn how each teacher—though one used older techniques than the other—were both able to engage students, showing that there is no "one right way" to teach. I really love the concepts between social constructivism but struggle with how it might work out in real life. However, Mr. Fine's approach is strategic and interesting, and I might be able to borrow some of his techniques.

ESOL and/or Special Needs

One of the many advantages to inquiry-based learning is that it creates a somewhat self-paced learning environment. When students engage with the materials in a free-form way, such as creating their own set of questions, they must start doing so at their own level of understanding. This concept which is widely applicable to all students with special needs. Inquiry-based learning and practice-heavy approaches encourage heterogenous learning (Hmelo-Silver et al., 2014) where relative improvement is the goal. Therefore, this is an approach that can be utilized in integrated classroom representing students at different achievement levels. The cooperative, social environment of a classroom like Mr. Fine's would also encourage student interaction, where higher-needs students can receive help from peers, and students who play a role in assisting their peers benefit as well from rehearsal of the content.

References

Hmelo-Silver, C. E., Liu, L., Gray, S., & Jordan, R. (2014). Using representational tools to learn about complex systems: A tale of two classrooms. *Journal of Research in Science Teaching, 52*(1), 6-35. doi:10.1002/tea.21187

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